Strait of Georgia Spiny Dogfish (*Squalus acanthias*) Longline Survey: Hook Comparison Study, November 12-25, 2004

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STRAIT OF GEORGIA SPINY DOGFISH (*Squalus acanthias*) LONGLINE SURVEY: HOOK COMPARISON STUDY, NOVEMBER 12-25, 2004

by

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ABSTRACT

McFarlane, G.A., King, J.R., Hodes, V.R., and Andrews, W.T. 2005. Strait of Georgia spiny dogfish (*Squalus acanthias*) longline survey: Hook comparison study, November 12-25, 2004. Can. Manuscr. Rep. Fish. Aquat. Sci. 2721: iv + 19 p.

From November 12-25, 2004, a longline survey for spiny dogfish (*Squalus Acanthias*) was conducted in the Strait of Georgia to compare catch per unit effort (CPUE) between J hook and Circle hook longline gear. At six locations, 22 sets (total of 5,400 hooks of each gear type) were fished by the *F/V Nordic Freedom* for CPUE comparison. With J hook gear, 838 spiny dogfish, ranging in length from 435 to 1112 mm were captured; while 1370 spiny dogfish between 400 to 1017 mm in length were captured on Circle hook gear. There was no significant difference in the mean spiny dogfish length (723 mm for both gear types). All captured male spiny dogfish were measured for length, sexed externally and then released; all female spiny dogfish were measured for length, stage of maturity was determined internally and second dorsal spines were removed for age estimation. Female spiny dogfish ranged in ages from 6 to 68 years. The Circle hook gear caught 1.6 times more spiny dogfish than the J hook gear. The J hook CPUE was calculated to be 153 per 1000 hooks while the Circle hook CPUE was 249 per 1000 hooks. Kruskal-Wallis ANOVA showed a significant effect for depth for both J hook ($p<0.0001$) and for Circle hook gear ($p<0.0001$) indicating spiny dogfish CPUE increased with depth for both types of gear. The increase in CPUE with depth was non-uniform and greater for the Circle hook gear than for the J hook gear. As a result of this survey, it is suggested that a correction factor be applied to CPUE data when comparing spiny dogfish catch rates by J hook to those by Circle hook for both research survey data and commercial data. If depth information is available, J hook CPUE should be standardized using a correction factor of 1.2 for depths less than 110 m, and 1.65 for depths greater than 110m. If no depth information is available a correction factor of 1.45 is suggested.

RÉSUMÉ

McFarlane, G.A., King, J.R., Hodes, V.R., and Andrews, W.T. 2005. Strait of Georgia spiny dogfish (*Squalus acanthias*) longline survey: Hook comparison study, November 12-25, 2004. Can. Manuscr. Rep. Fish. Aquat. Sci. 2721: iv + 19 p.

Un relevé de l'aiguillat commun (*Squalus acanthias*) a été effectué du 12 au 25 novembre 2004 dans le détroit de Georgia aux fins de comparaison des prises par unité d'effort (PUE) de pêche à la palangre munie d'hameçons en J et à la palangre munie d'hameçons circulaires. À cette fin, le navire de pêche *Nordic Freedom* a effectué 22 mouillages à six endroits (5 400 hameçons au total pour chaque type de palangre). Avec l'engin muni d'hameçons en J, 838 aiguillats, de longueur allant de 435 à 1 112 mm, ont été capturés, et avec l'engin muni d'hameçons circulaires, 1 370 aiguillats, de longueur allant de 400 à 1 017 mm. Aucune différence significative dans la longueur moyenne des aiguillats capturés à l'aide deux engins n'a été relevée (723 mm pour les deux engins). Tous les mâles ont été mesurés; après confirmation de leur sexe par examen des structures externes, ils ont été remis à l'eau. Toutes les femelles ont aussi été mesurées; leur stade de maturité a été déterminé par examen des structures internes et la deuxième épine dorsale prélevée aux fins d'estimation de l'âge, qui variait de 6 à 68 ans. Les prises aux hameçons circulaires étaient 1,6 fois les prises aux hameçons en J. Les PUE avec des hameçons en J se chiffraient à 153 par 1 000 hameçons et avec des hameçons circulaires, à 249 par 1 000 hameçons. Une analyse de la variance de Kruskal-Wallis a révélé un effet significatif de la profondeur pour les deux types d'hameçons ($p < 0,0001$), les PUE augmentant en fonction de la profondeur. Par contre, cette augmentation des prises selon la profondeur n'était pas uniforme; elle était plus marquée dans le cas des hameçons circulaires. On propose donc qu'un facteur de correction soit appliqué aux données sur les PUE lorsqu'on compare les taux de capture obtenus avec des hameçons en J et des hameçons circulaires dans le cas des données de relevé de recherche et des données de pêche commerciale. Si la profondeur est connue, les PUE pour les hameçons en J devraient être normalisées à l'aide d'un facteur de correction de 1,2 pour les profondeurs inférieures à 110 m, et de 1,65 pour les profondeurs supérieures à 110 m. Si la profondeur est inconnue, on propose d'utiliser un facteur de correction de 1,45.

INTRODUCTION

Despite the commercial importance of spiny dogfish (*Squalus acanthias*) in the Strait of Georgia, a survey has not been conducted by Fisheries & Oceans Canada since 1989. Spiny dogfish surveys were conducted in October 1986 and 1989 in the Strait of Georgia using typical commercial longline gear ("J" hooks). Surveys are an important component for assessing the status of fish stocks and can provide invaluable information on abundance, distribution, biological data and age composition. Recent concerns regarding the exploitation of elasmobranch species highlighted the need to conduct a survey on spiny dogfish in the Strait of Georgia. However, the standard gear used in the commercial longline fishery for spiny dogfish has changed since 1989, from J hooks to Circle hooks, making it difficult to obtain J hook gear. Future spiny dogfish surveys will need to be conducted using the more prevalent Circle hook gear. As the name implies, J hooks are shaped like the letter J. Circle hooks are modified J hooks, in which the point of the hook has been bent perpendicularly towards the shank. Circle hooks are believed to be better at retaining caught fish (i.e. have a higher catch rate) and to be safer to handle. In order to calibrate catch rates from previous surveys to future surveys, a comparison on catch rates between the two different types of gear was conducted from November 12-25, 2004. The comparison in catch rates can also be applied to calibrate commercial catch rates between the two types of gear.

Methods

All fishing was conducted onboard the *F.V. Nordic Freedom*, a 12 m longline vessel that participates in the commercial longline fishery for spiny dogfish in the Strait of Georgia and off the west coast of Vancouver Island.

Six sample sites from the previous surveys were selected throughout the southern Strait of Georgia: Active Pass, Porlier Pass, Halibut Bank, Hornby Island, Sinclair Bank, and Epson Point (Figure 1). Theses six sites were surveyed during both the 1986 and 1989 surveys. In previous surveys, the catch rates of spiny dogfish at these sites were high. These sample sites also represent important commercial fishing areas and are accessible during bad weather conditions. In addition, Northumberland Channel (Figure 1) was also surveyed in order to collect biological samples. The catch rates for Northumberland Channel are reported here, but were not used in catch rate analyses.

As with previous surveys, each site was divided into 5 depth strata:

1) 0 to 55 m
2) 56 to 110 m
3) 111 to 165 m
4) 166 to 220 m
5) greater than 220 m

Weather permitting, longline gear was set within each depth strata at each of the sample sites. However, bad weather conditions required the curtailing of fishing effort and for some sample sites only 4 of the 5 depth strata could be fished. In bad weather conditions, the deepest depth stratum (greater than 220 m) was excluded.

Each longline set consisted of a leaded groundline (3/8 inches in diameter) attached to an anchored buoyline at each end. Model 72 snaps (3 cm in width; 13 cm in length), made from 3.2 mm stainless steel wire, were attached to the groundline with a spacing of 2 m. Snap gangions 30 cm long (monofilament) were fitted with either a J hook or a Circle hook. The same J hooks were used as in previous studies: #12/0 stainless steel Mustad J. Circle hooks used in the commercial longline spiny dogfish fishery were used: #14/0 Mustad Circle. Each groundline was deployed with 250 J hooks and 250 Circle hooks, for a total of 500 hooks per set. Each hook was baited with frozen herring. Large orange floats were towed behind the vessel, one from each side, while longline gear was being set in order to deter birds from attacking the baited hooks as they went overboard.

The effective fishing time for each set was recorded as the time from when the first hook was deployed until the last hook was retrieved. In order to minimize bias in catch rates due to differences in effective fishing time, all longline sets were fished for 1.5 to 3 hours.

All spiny dogfish caught were counted and retained for biological sampling. Other species were identified and counted, but were immediately released. Sex of spiny dogfish was determined externally. Male spiny dogfish were released after their length was measured. Total length (mm) was measured from the tip of the snout to the tip of the upper lobe of the caudal fin when in a straight line with the body. Maturity stages for female spiny dogfish were determined internally. Maturity stages are presented in Appendix 1. Briefly, female maturity description has two parts: one describing the condition of the ovaries; a second describing the condition of the uteri. Females with either large ovarian eggs or yolk sac embryos were considered mature. The second dorsal spine from the female spiny dogfish were removed and retained for age estimation.

Catch per unit effort (CPUE) for a longline set was calculated as the total number of spiny dogfish caught per thousand of hooks. To test for differences in catch rate between J hooks and Circle hooks, we used a Wilcoxon Signed Rank Test for paired CPUE by longline set. To test for differences between depth strata for each gear type we used Kruskal-Wallis Two-Way ANOVA with site and depth strata as factors. Differences in mean length of spiny dogfish caught (by gear type, by depth strata) were tested with two-tailed t-tests.

RESULTS

Fishing was conducted from November 12-25, 2004. Extreme bad weather conditions curtailed the number of fishing days and depth strata sampled. A total of 22 longline sets were deployed across six sites (Appendix 1). One longline set was fished at Northumberland Channel to collect biological samples (Appendix 1). The number of depth strata at each site varied: strata 1-4 were fished at Hornby Island, Sinclair Bank, and Porlier Pass: strata 2-4 in Halibut Bank; strata 1, 2 and 4 were fished at Epsom Point; strata 4-5 were fished at Active Pass. Due to time constraints only the deeper strata were fished in Active Pass in order to maximize biological samples for females. With the exception of 1 longline set at Sinclair Bank (depth stratum 1), 250 hooks of each gear type were deployed at each depth strata. The bottom

habitat available in the shallow stratum at Sinclair Bank was limited, and only 150 hooks of each gear type could be deployed there. In total, 5,400 J hooks were deployed and 5,400 Circle hooks were deployed during the survey.

A total of 2,208 spiny dogfish were caught: 1,655 male and 553 female (Appendix 2). Catch of other species was relatively low with lingcod (*Ophiodon elongatus*), yelloweye rockfish (*Sebastes ruberrimus*) and ratfish (*Hydrolagus colliei*) the most frequent finfish encountered (Appendix 2).

Catch Per Unit Effort

The CPUE of spiny dogfish was higher for the Circle hook gear than for the J hook gear (Table 1: Wilcoxon Signed Rank Test, p=0.0016). Overall, the Circle hook gear caught 1.6 times more spiny dogfish than the J hook gear (J hook CPUE=153 · 1000 hooks^{-1}; Circle hook CPUE=249·1000 hooks^{-1}). In addition, the Circle hook gear CPUE for both male spiny dogfish (p=0.0012) and for female spiny dogfish (p=0.04) were also 1.6 times higher than the CPUE for J hook gear (Table 1). Circle hook gear consistently caught more spiny dogfish catch than the J hook gear (Figure 2). Overall this proportion increased with depth for the Circle hook gear, but decreased with depth for the J hook gear (Figure 3).

The depth strata 2, 3 and 4 were sampled in five of the six sites (Hornby Island; Sinclair Bank; Epsom Point; Halibut Bank; Porlier Pass). Using these sites, Kruskal-Wallis ANOVA for depth effect (depth strata 2, 3 and 4) on spiny dogfish CPUE was significant for J hook ($p<0.0001$) and for Circle hook gear ($p<0.0001$) indicating for both types of gear that spiny dogfish CPUE increased with increasing depth (Table 2). ANCOVA for the spiny dogfish CPUE at these sites indicates an interaction between depth and hook type ($F=22.04$, $df=24$, $p<0.0001$). In addition, the CPUE of male and female spiny dogfish increased with increasing depth for each hook type (Table 2). Overall, the increase in CPUE with increasing depth was greater for the Circle hook gear than for the J hook gear ($F=7.12$, $df=15$, $p=0.0129$; Table 2). This means that the difference in CPUE with depth by hook type is not uniform: the Circle hook CPUE is 1.2 times higher than the J hook CPUE in the shallower stratum (2); but the difference levels off at deeper depths and is 1.6 times higher in stratum 3 and 1.7 times higher in stratum 4. This may indicate the greater efficiency of the Circle hook gear at retaining spiny dogfish, particularly when the gear is hauled from greater depths.

Biological Data

Detailed length frequency data by set is presented in Appendix Table 4. Male spiny dogfish ranged in size from 435 mm to 915 mm (Table 3). Female spiny dogfish ranged in size from 400 mm to 1112 mm (Table 3). Spiny dogfish captured by J hook (n= 838) ranged in size from 435 to 1112 mm, with a mean size of 723 mm (Table 3). Spiny dogfish captured by Circle hook (n=1370) ranged in size from 400 to 1017 mm, with a mean size of 723 mm (Table 3). There was no significant difference in the mean length of spiny dogfish captured by hook type (two tailed t-test: $F=1.09$; $p=0.097$). Overall, larger spiny dogfish were captured at deeper depths.

The stage of maturity was determined for 537 female dogfish: 80.82% were immature; 12.66% were maturing and 6.52% were mature (Table 4).

Of 538 spines collected for ageing from female dogfish, 533 were aged and 5 were found unreadable. Estimated ages ranged from 6 to 68 years with a modal length of 30 years (Figure 4). There is a general agreement with increasing size-at-age with larger variation in size as ages increase (Figure 5).

DISCUSSION

Overall the Circle hook gear caught more spiny dogfish than the J hook gear and the efficiency at retaining captured spiny dogfish increased with depth. A correction factor should be applied to CPUE data when comparing spiny dogfish captured by J hook to those captured by Circle hooks. This applies to research survey data and to commercial data. When depth information is available, CPUE should be standardized with varying correction factors. We suggest that for depths less than 110 m that CPUE data from J hook gear be corrected by a factor of 1.2. This correction factor for CPUE data from depths greater than 110 m should be 1.65. If depth data are not available, a reasonable approach might be to use a constant correction factor of 1.45. There was no difference in the mean size of spiny dogfish captured by the two different hook types, so biological data from research surveys or commercial fisheries that used J hook gear should be comparable to data obtained with Circle hook gear.

ACKNOWLEDGEMENTS

Funding for the charter of the *F.V. Nordic Freedom* and bait was supplied by the BC Dogfish Hook and Line Industry Association. Wayne Ricketts (Skipper) and Bryon Hamber were the crew aboard the *F.V. Nordic Freedom*.

Table 1. Spiny dogfish CPUE (number of dogfish per 1000 hooks) by site, depth stratum, area and hook type.

Site	Depth Stratum	Set Number	Male CPUE		Female CPUE		Total CPUE	
			J Hook	Circle Hook	J Hook	Circle Hook	J Hook	Circle Hook
Hornby	1	1	48	52	0	0	48	52
Hornby	2	2	8	96	0	0	8	96
Hornby	3	3	136	360	16	0	152	360
Hornby	4	4	256	512	16	20	272	532
Sinclair Bank	1	8	7	0	13	0	20	0
Sinclair Bank	2	7	0	4	36	88	36	92
Sinclair Bank	3	6	4	8	48	100	52	108
Sinclair Bank	4	5	20	32	204	332	224	364
Epson Point	1	11	0	0	0	4	0	4
Epson Point	2	10	40	8	80	36	120	44
Epson Point	4	9	72	168	132	312	204	480
Halibut Bank	2	15	48	52	0	4	48	56
Halibut Bank	3	12	96	188	16	32	112	220
Halibut Bank	3	13	236	240	52	16	288	256
Halibut Bank	4	14	336	588	24	28	360	616
Porlier Pass	1	18	0	8	0	0	0	8
Porlier Pass	2	19	28	4	4	0	32	4
Porlier Pass	3	17	52	100	8	8	60	108
Porlier Pass	4	16	372	500	52	60	424	560
Active Pass	4	21	232	432	28	88	260	520
Active Pass	5	20	240	396	104	108	344	504
Active Pass	5	22	240	404	56	92	296	496
	Mean CPUE:		112.30	188.73	40.42	60.36	152.73	249.09

Table 2. Mean CPUE (number of dogfish per 1000 hooks) by depth strata (2, 3, 4) for Hornby, Sinclair Bank, Epson Point, Halibut Bank and Porlier Pass.

Depth	Male CPUE		Female CPUE		Total CPUE	
Stratum	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks
2	24.8	32.8	24	25.6	48.8	58.4
3	104.8	179.2	28	31.2	132.8	210.4
4	211.2	360	85.6	150.4	296.8	510.4
Mean CPUE:	113.60	190.67	45.87	69.07	159.47	259.73

Table 3. Summary (mean, minimum, maximum) of total length (mm) data for spiny dogfish captured by J hook gear and circle hook gear by depth stratum.

Depth Stratum	Hook Type	Male Spiny Dogfish Total Length (mm)			Female Spiny Dogfish Total Length (mm)			All Spiny Dogfish Total Length (mm)		
		Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1	J	829.62	679	901	952.00	949	955	845.93	679	955
	Circle	840.20	750	911	930.00	930	930	845.81	750	930
2	J	745.71	551	915	812.66	626	1010	778.07	551	1010
	Circle	757.93	650	819	781.72	565	955	768.36	565	955
3	J	730.77	435	905	663.57	457	1000	716.60	435	1000
	Circle	737.78	560	885	722.87	437	1006	735.57	437	1006
4	J	720.74	489	880	719.35	535	962	720.37	489	962
	Circle	717.26	485	895	717.25	400	1017	717.26	400	1017
5	J	716.21	468	910	668.54	510	1112	704.07	468	1112
	Circle	720.69	500	876	658.86	529	979	708.32	500	979

Table 4. Observed maturity stages for female spiny dogfish. For a full description of maturity codes see Appendix 1.

Maturity State	Maturity Code	Number of Fish	Proportion of Total Sample (%)
Immature	10	91	16.95
	50	154	28.68
	51	149	27.75
	52	2	0.37
	53	38	7.08
Total Immature:		434	80.82
Maturing	55	4	0.74
	56	50	9.31
	70	1	0.19
	71	8	1.49
	73	3	0.56
	75	2	0.37
Total Maturing:		68	12.66
Mature	77	23	4.28
	78	0	0.00
	79	1	0.19
	95	5	0.93
	97	3	0.56
	99	3	0.56
Total Mature:		35	6.52

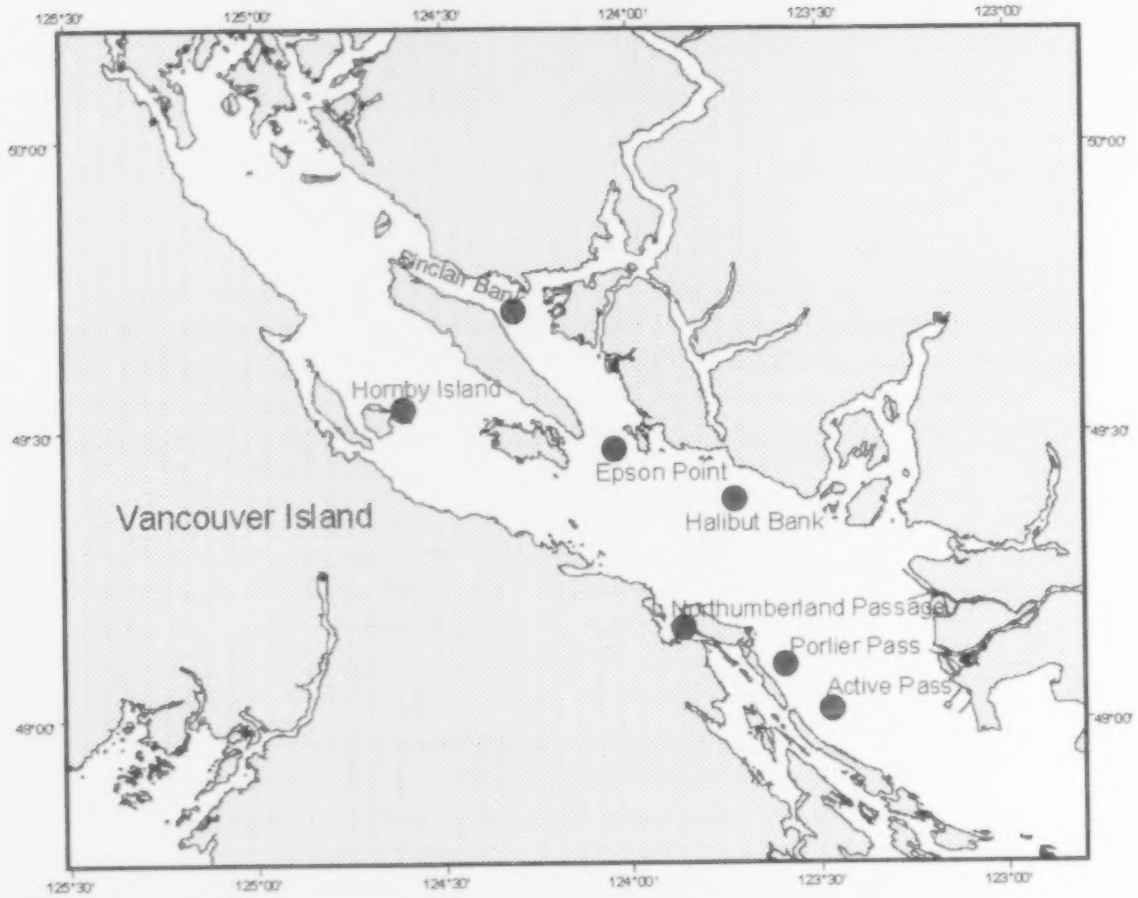

Figure 1. Longline set locations in the Strait of Georgia occupied by *F/V Nordic Freedom* between November 12-25, 2004. Seven sample sites were surveyed. For detailed set and catch information see Appendix 2.

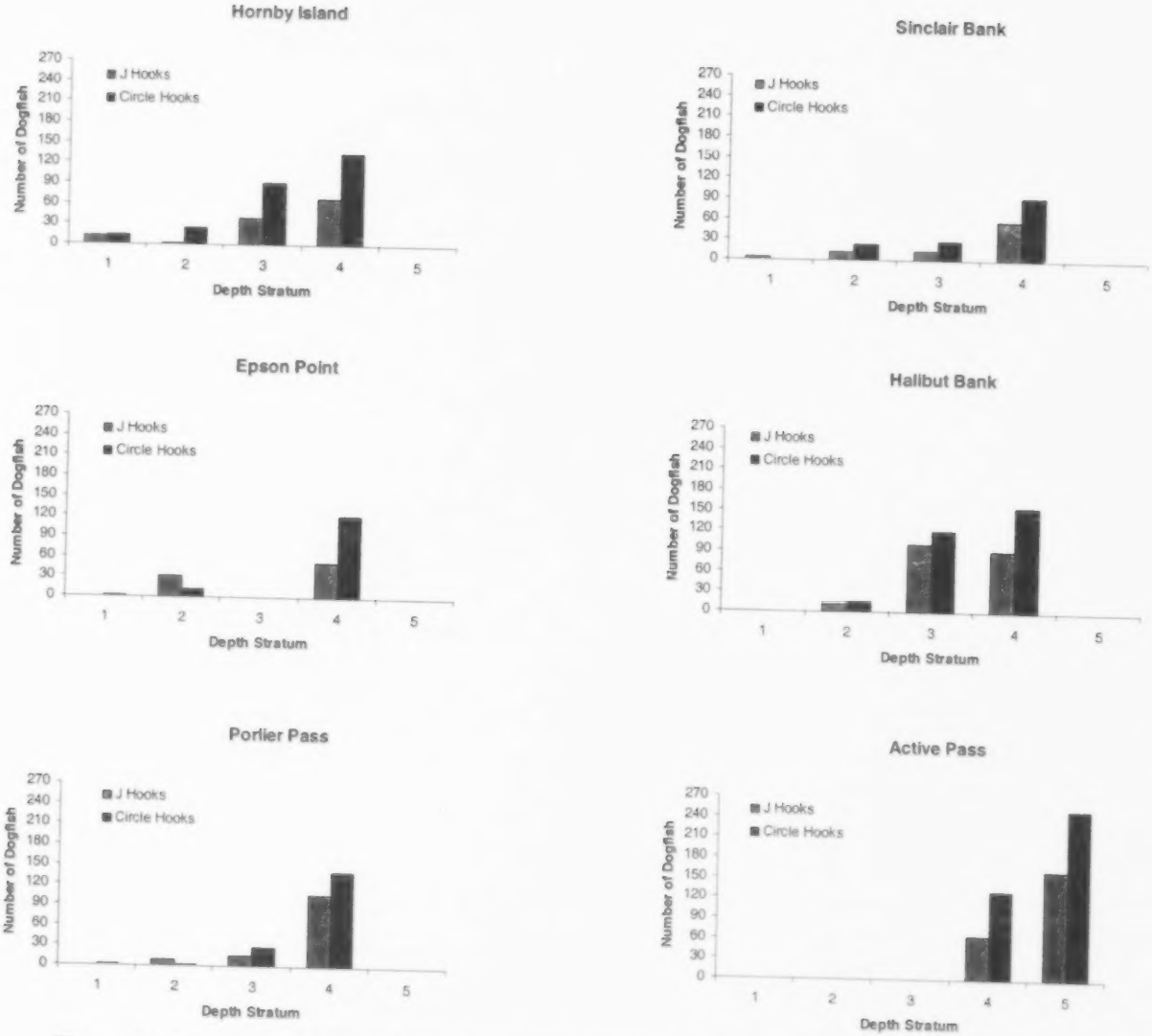

Figure 2. Spiny dogfish catch by hook type and area. Depth stratum 5 was fished only at Active Pass. At Sinclair Bank depth stratum 1 was fished with 150 hooks. At Halibut Bank, depth stratum 3 was fished twice.

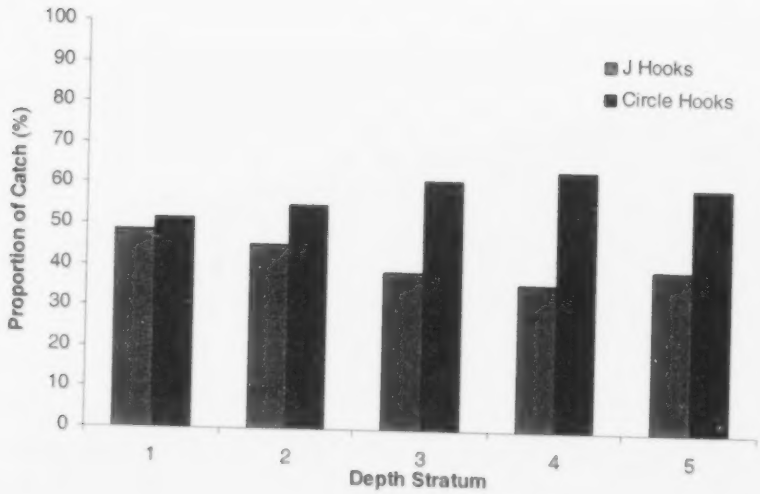

Figure 3. Proportion of spiny dogfish catch by hook type and depth strata.

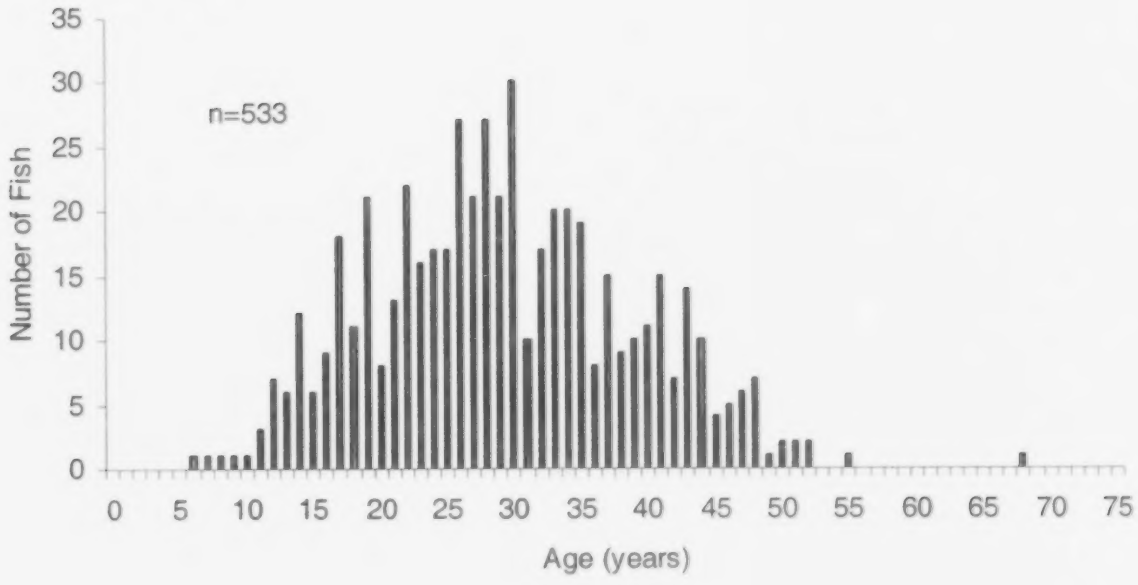

Figure 4. Age composition of female spiny dogfish.

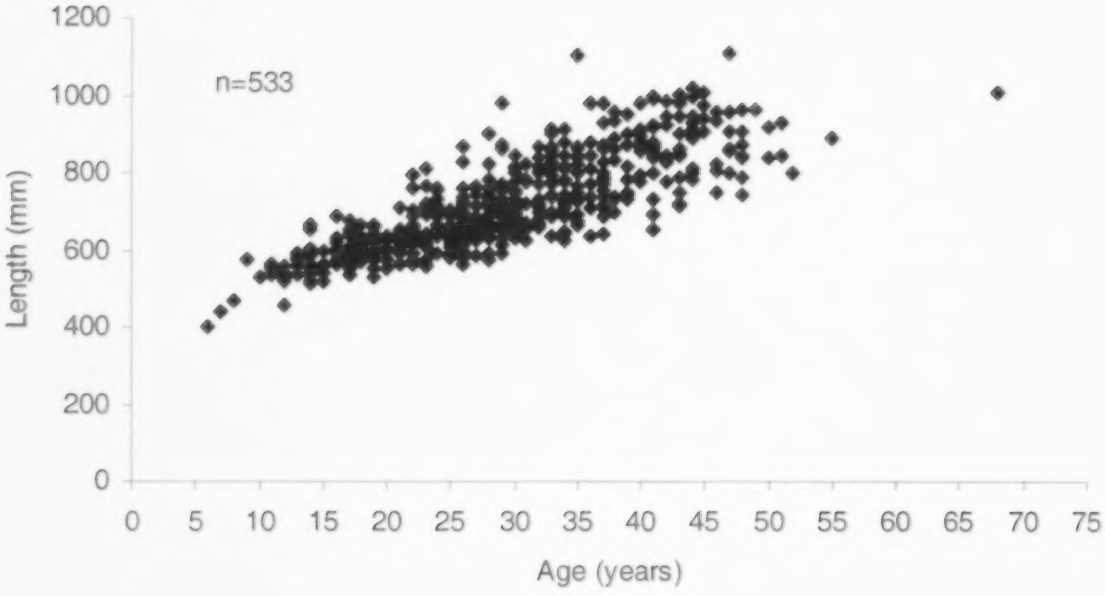

Figure 5. Length-at-age of female spiny dogfish.

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Appendix 1. Description of female spiny dogfish maturity codes.

Maturity Code		Ovaries		Uteri	Maturity Stage
10	I-1	Ova small, 0-5 mm diameter white firm ovary<1/4 length of body cavity.	D-1	Thin no thickening	Immature
50	R-1	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	D-1	Thin no thickening	Immature
51	R-1	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	D-2	Thin, <5mm thickened section, <1/4 length of body cavity	Immature
53	R-1	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	D-3	About 5mm thickened section < 1/4 length of body cavity	Immature
55	R-1	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	D-4	Thickened section at least 10mm or wider, flaccid; >1/3 length of body cavity	Maturing
56	R-1	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	D-5	Encapsulated uterine eggs (candles)	Maturing
70	R-2	Ova yellow firm <30mm	D-1	Thin no thickening diameter	Maturing
71	R-2	Ova yellow firm <30mm	D-2	Thin, <5mm thickened section, <1/4 length of body cavity	Maturing
73	R-2	Ova yellow firm <30mm	D-3	About 5mm thickened section < 1/4 length of body cavity	Maturing
75	R-2	Ova yellow firm <30mm	D-4	Thickened section at least 10mm or wider, flaccid 1/3 length of body cavity	Maturing
77	R-2	Ova yellow firm <30mm	D-6	Yolk sac pups	Mature
78	R-2	Ova yellow firm <30mm	D-7	Term pups (no yolk sac)	Mature
79	R-2	Ova yellow firm <30mm	D-8	Flaccid	Mature
95	R-3	Ova white firm <10mm in diameter and yellow firm > 30mmin diameter; ovary flacid 1/3 length of body cavity	D-4	Thickened section at least 10mm or wider, flaccid; >1/3 length of body cavity	Mature
97	R-4	Ova white firm <10mm in diameter and yellow firm > 30mmin diameter; ovary flacid 1/3 length of body cavity	D-6	Yolk sac pups	Mature
99	R-5	Ova white firm <10mm in diameter and yellow firm > 30mmin diameter; ovary flacid 1/3 length of body cavity	D-8	Flaccid and empty	Mature

Appendix 2. Bridge log from the spiny dogfish longline survey conducted in the Straight of Georgia onboard F/V Nordic Freedom, November 12-25, 2004

Set Number	Location	Depth Strata	Date	Number of Hooks		Start Latitude	Start Longitude	End Latitude	End Longitude	Start Time	Finish Time	Effective Fishing Time (min)	Start Depth (m)	Finish Depth (m)
				J Hooks	Circle Hooks									
1	Hornby Island	1	13-Nov-04	250	250	49 32.2998	124 36.148	49 32.796	124 38.383	07:15	09:19	124	53.0	53.0
2	Hornby Island	2	13-Nov-04	250	250	49 32.32	124 37.12	49 33.04	124 38.28	08:49	11:13	144	91.4	98.8
3	Hornby Island	3	13-Nov-04	250	250	49 32.07	124 35.27	49 32.47	124 36.34	10:52	13:39	167	144.9	118.9
4	Hornby Island	4	13-Nov-04	250	250	49 33.98	124 36.267	49 35	124 37.38	13:00	15:01	121	175.6	173.7
5	Sinclair Bank	4	15-Nov-04	250	250	49 42.45	124 18.33	49 42.02	124 18.02	12:45	14:53	128	220.0	203.0
6	Sinclair Bank	3	15-Nov-04	250	250	49 43.45	124 18.267	49 42.716	124 17.6933	14:11	17:09	178	150.0	126.2
7	Sinclair Bank	2	15-Nov-04	250	250	49 41.8116	124 17.033	49 42.72	124 17.33	16:41	18:50	129	73.2	111.6
8	Sinclair Bank	1	15-Nov-04	150	150	49 42.23	124 16.46	49 41.47	124 16.27	18:30	20:40	130	54.9	53.0
9	Epsom Point	4	17-Nov-04	250	250	49 28.1667	124 2.265	49 27.66	124 0.988	06:11	08:23	132	195.7	197.5
10	Epsom Point	2	17-Nov-04	250	250	49 29.85	124 2.75	49 29.144	124 1.819	07:33	10:32	179	75.0	95.1
11	Epsom Point	1	17-Nov-04	250	250	49 30.95	124 2.784	49 30.084	124 2.544	10:16	12:03	107	34.7	29.3
12	Halibut Bank	3	19-Nov-04	250	250	49 22.928	123 43.376	49 23.43	123 44.869	08:29	10:35	126	109.7	124.4
13	Halibut Bank	3	19-Nov-04	250	250	49 22.715	123 43.625	49 23.111	123 45.12	09:47	12:03	136	113.4	137.2
14	Halibut Bank	4	19-Nov-04	250	250	49 21.713	123 43.785	49 21.062	123 42.359	13:24	15:36	132	182.9	184.7
15	Halibut Bank	2	19-Nov-04	250	250	49 20.406	123 42.704	49 20.903	123 43.837	14:29	16:52	143	91.4	86.0
16	Porlier Pass	4	20-Nov-04	250	250	49 5.611	123 35.537	49 4.71	123 35.822	07:38	09:57	139	219.5	204.8
17	Porlier Pass	3	20-Nov-04	250	250	49 4.156	123 36.21	49 3.52	123 35.813	09:02	11:07	135	120.7	124.4
18	Porlier Pass	1	20-Nov-04	250	250	49 0.696	123 33.681	49 59.944	123 32.849	12:51	15:02	131	45.7	51.2
19	Porlier Pass	2	20-Nov-04	250	250	49 59.953	123 32.666	49 59.323	123 31.578	14:32	16:34	122	64.0	89.6
20	Active Pass	5	21-Nov-04	250	250	49 0.907	123 28.116	49 0.401	123 27.107	07:30	09:38	128	239.6	245.1
21	Active Pass	4	21-Nov-04	250	250	49 0.249	123 28.258	48 59.703	123 27.478	08:50	10:58	128	219.5	215.8
22	Active Pass	5	21-Nov-04	250	250	49 0.604	123 27.54	49 0.139	123 26.66	12:12	13:48	96	245.1	243.2
23	Northumberland Channel	N/A	22-Nov-04	334	260	49 9.484	123 51.799	49 10.461	123 52.409	08:04	09:28	84	69.0	82.3

Appendix 3. Total catch in pieces by set, depth stratum and hook type of Spiny dogfish (*Squalus acanthias*), Copper rockfish (*Sebastes caurinus*), Greenstripe rockfish (*S. elongatus*), Quillback rockfish (*S. maliger*), Yelloweye rockfish (*S. ruberrimus*), Lingcod (*Ophiodon elongatis*), Spotted ratfish (*Hydrolagus colliei*), Pacific Sanddab (*Citharichthys sordidus*) and Rocksole (*Lepidopsetta bilineata*) from the spiny dogfish longline survey conducted in the Straight of Georgia onboard *F/V Nordic Freedom*, November 12-25, 2004.

		Catch (pieces)																	
		J-hook								Circle hooks									
Set Number	Depth Stratum	Female Dogfish	Male Dogfish	Copper	Quillback	Lingcod	Ratfish	Pacific sanddab	Yelloweye	Female Dogfish	Male Dogfish	Copper	Greenstripe	Quillback	Lingcod	Ratfish	Pacific sanddab	Rocksole	Yelloweye
1	1		12	2	1		2				13	1			9				
2	2		2								24								
3	3	4	34				1				90								1
4	4	4	64							4	128								
5	4	51	5				1			83	8					1			2
6	3	12	1				3			25	2	2				1			
7	2	9					3		1	22	1			1		1			1
8	1	2	1				1									4			
9	4	33	18							78	42								12
10	2	20	10						1	9	2	3							
11	1					1				1					1			1	
12	3	4	24							8	47								
13	3	13	59							4	60								
14	4	6	84							7	147								
15	2	0	12							1	13				1				2
16	4	13	93							15	125								
17	3	2	13							2	25	3	1						4
18	1										2	2			3				
19	2	1	7				1	1			1						1		1
20	5	26	60							27	99								
21	4	7	58							22	108								
22	5	14	60							23	101								
	Total:	221	617	2	1	1	12	1	2	331	1038	11	1	1	14	7	1	1	23
23	N/A	19			1	3	6		3					3	1	1			4

Appendix. 4. Spiny dogfish length frequency data by set from the spiny dogfish longline survey conducted in the Straight of Georgia onboard *F/V Nordic Freedom*, November 12-25, 2004.

Set	1		2		3		4		5		6		7	
Length Interval	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks
(mm)	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female
400														
450														
500						1		1 2		1		1		
550							2	6 2		1	1 4	1	3	1
600					1	1 5	7 2	17	3	5	1 2	1	2	2 1
650				2	1	6	10	14 1	1	6	3 8	3	2 3	1 1
700				5	7	2 18	30 1	53		10	1 12	2	3	1 8
750		1	2	15	14	43	13	31	1	10	1 13	1 1	3	1 3
800	6	7		2	8	14	2	5		7	1 11	3	3	3
850	5	4			3	4				7	20		4	3 3
900	1	1						1		2	9	1	2	2 2
950										2	2		1	
1000											1		1	
1050														
1100														
1150														

Set	8		9		10		11		12		13		14	
Length Interval	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks	Circle Hooks
(mm)	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female	Male Female
400										1	1			1
450											2		1	
500				1 4						1		1		3 4
550			1 2	5 9					2 1	1 2	3 7	4 1	4 1	1
600			3 6	12 24		1			4 3	4 1	8 1	8 2	13 3	11
650	1		4 9	7 11	1 2				5	13 2	12 3	13	8 1	11 1
700			9 7	10 13	5 3	1 1			8	9	20	17	31 1	59 1
750			1 4	6 4	2	1 2			5	15 1	12	12	21	55
800			1	1 9	1 6	1				5	2	5	5	7
850			3	2	1 3	3					1	1	1	
900				2	2	1		1						
950	2		1		2	1								
1000					1									
1050														
1100														
1150														

Appendix. 4. Continued

Set	15				16				17				18		19		20			
Length	J Hooks		Circle Hooks		J Hooks		Circle Hooks		J Hooks		Circle Hooks		J Hooks	Circle Hooks	J Hooks	Circle Hooks	J Hooks		Circle Hooks	
Interval (mm)	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
400																				
450																				
500																			2	1
550				1	1	2	4								2		6	5	6	3
600	1				5	4	5	2							1		8	5	9	7
650					12	3	23	5			3				1		7	6	9	8
700	2		2		29	1	35	3			6				1		18	4	36	5
750	3		6		39	2	43	2	4		9				2	1	17	5	22	2
800	4		5		6		15		4		2			2			3		12	
850	1				1	1			1		5						1		3	
900	1							1	4											
950								1		1		1						1		1
1000								1		1		1								
1050																				
1100																1				
1150																				

Set	21				22				23	
Length	J Hooks		Circle Hooks		J Hooks		Circle Hooks		misc hooks	
Interval (mm)	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
400										
450			1		1					
500	2		1			1	2			
550	5		5	8	3	2	5	6		
600	3	2	10	5	4	7	11	6		
650	3	2	13	4	12	3	11	10		
700	3	1	34	2	12	1	27			
750	22	1	31	1	18		28			2
800	16	1	12		6		15			4
850	4		1	1	2		2			5
900				1	2			1		3
950										3
1000										1
1050										
1100										1
1150										